dow in an otherwise close room, and no air will enter: no air can enter, indeed, unless force be applied as with a bellows, whereby as much may be driven out as is driven in, with the effect only of diluting not of purifying. Even at that short season of the year in which windows may be freely opened, unless windows are so placed as to admit of the processes of out-door ventilation being carried on through them by a thorough draught from low levels to high levels, open windows are not sufficient to effect thorough in-door ventilation. There must for this purpose be in every room a way by which a draught can be obtained, and this draught must take effect upon the most impure air of the room, which is that of the highest level. The chimney opening may supply a way at a low level, and a draught may be established between it and the window, but the air removed from the room by such a draught is not necessarily the spent or foul air. But make an opening into the chimney flue near the highest level in the room, that is to say, as near as may be to the ceiling, and if a draught be established between the window and the flue by this opening the ventilation is complete; that is to say again, if there be draught enough in the chimney flue from any cause to induce an up-current through it, or if there be motion of the external air to drive the air in at the window and force an up-current through the flue.

Windows may not be put open in the long nights during colder season, however, and for the same reason in-draughts of the outer air by any other channel are offensive and injurious. To open a door for the sake of air is but a modification of opening a window, and, if the door be an internal one, with the effect of admitting already enclosed, and, probably, contaminated air. Means of efficient in-door ventilation must, therefore, be independent of windows and doors; and the means should be such as will lead to a result at once wholesome and agreeable.

Many plans have been suggested, and some have been carried into effect, of warming air, and then forcing it into, or drawing it through, buildings, and, in the process of doing so, removing the foul or spent air from the apartments to which it may be applied. Some of these plans are more and some are less available to wholesome and agreeable in-door ventilation, but even the best are rather adapted to large apartments, such as those of hospitals, churches, theatres, and assembly-rooms, than to private dwelling-houses in which the rooms are small and labour and cost are to be economised.

Plans have been proposed, too, for the economical ventilation of dwelling-houses; but they seem to be all in a greater or less degree imperfect. Ways of access are provided in these cases for the outer air directly to the fire in every apartment, to feed the fire, and incidentally to ventilate the room; way of egress in addition to the chimney opening and the chimney flue being sometimes provided for the vent air of the room; sometimes, indeed, as before indicated, by an opening into the chimney flue near the ceiling. A direct indraught of cold air is not agreeable, and it may be pernicious, but if the outer air become warm in its way to the inmates of the room, the objection to its directness ceases. If, however, the warmth is imparted to it with foulness, the process does not fulfil the condition as to wholesomeness, and this is the case when the outer air is admitted at or near to the ceiling to take up warmth from the spent and heated atmosphere of the higher levels. Having undergone this process, it is not the fresh air that comes warmed to the inmates, but a mixture of fresh and foul air that cannot be agreeable to any inmate conscious of the nature of the compound.

The endeavour on the present occasion is to show how the familiar fire of an apartment may be made to fulfil all the conditions necessary to obtain in-door ventilation, to the extent required of the apartment in which the fire may be maintained, and while it is maintained.

A fire in an ordinary grate establishes a draught in the flue over it with power according to its own intensity, and it acts with the same effect, at least, upon the air within its reach, for the means which enable it to establish and keep up the draught in the flue. The fire necessarily heats the grate in which it is kept up, and the materials of which grates are composed being necessarily incombustible, and being also ready recipients and conductors of heat, they will impart heat to whatever may be brought into contact with them.

It is supposed that the case containing the body of the grate is set on an iron or stone hearth in the chimney recess, free of the sides and back, except as to the joints in front. Let all communication between the chamber so formed about the back and sides of the grate and the chimney flue be shut off by an iron plate, open only for the register flap or valve over the fire itself. External air is to be admitted to the closed chambers thus obtained about the grate by a tube or channel leading through the nearest and most convenient outer wall of the building, and between the joists of the floor of the room, to and under the outer hearth or slab before the fire, and so to and under the back hearth, in which sufficient holes may be made to allow the air entering by the tube or channel to rise into the chamber about the fire-box or grate. Openings taking any form that may be agreeable are to be made through the cheeks of the grate into the air chamber at the level of the hearth. In this manner will be provided a free inlet for the outer air to the fire-place and to the fire, and of the facility so provided the fire will readily avail itself, to the abolition of all illicit draughts. But the air, in passing through the air chamber in its way to the fire which draws it, is drawn over the heated surfaces of the grate, and it thus becomes warmed, and in that condition it reaches the apartment.

An upright metal plate set up behind the openings through the cheeks of the grate, but clear of them, will bend the current of warmed air in its passage through the inlet holes, and thus compel the fire to allow what is not necessary to it to pass into the room; and if the opening over the fire to the flue be reduced to the real want of the fire, the consumption of air by the fire will not be so great as may be supposed, and there will remain a supply of tempered air waiting only an inducement to enter for the use of the inmates of the apartment. An opening directly from the room into the flue upon which the fire is acting with a draught more or less strong, at a high level in the room, will afford this inducement: it will allow the draught in the flue to act upon the heated and spent air under the ceiling, and draw it off; and in doing so will induce a flow of the fresh and tempered air from about the body of the grate into the room.

The mode thus indicated of increasing the effect of the familiar fire, and making it subservient to the important function of free and wholesome ventilation, is not to be taken as a mere suggestion, and now for the first time made. It has been in effective operation for six or seven years, and is found to answer well with the simple appliances referred to. But it is the mode and the principle of action that it is desired to recommend, and not the appliances, since persons more skilled in mechanical contrivances than the author professes to be, may probably be able to devise others better adapted to the purpose.*

The mode referred to of warming and ventilating apartments by their own fires is most easy of application, and in houses of all kinds, great and small, old and new, and as the warmth derived from the fire in any case comes directly by the in-draughted air, as well as by radiation of heat into the air of the apartment, fuel is economised. If the register flap be made to open and shut, by any means which give easy command over it, so that it may be opened more or less according to the occasion, and this be attended to, the economy will be assured; for it is quite unnecessary to leave the same space open over the fire after the steam and smoke arising from fresh fuel have been thrown off, as may be necessary immediately after coaling. The opening by the register valve into the flue may be reduced when the smoke has been thrown off so as to check the draught of air through the fire, and greatly to increase the draught by the upper opening into the flue, to the advantage of the ventilation and to the saving of fuel, while the heat from the incandescent fuel will be thereby rather increased than diminished.

Moreover the system being applicable in the cottage of the labourer, as fully and as easily as in the better appointed dwellings of those who need not economize so closely as labouring people are obliged to economize, the warmed air about the grate in a lower room may be conveyed directly from the air-chamber about the grate, by a metal or pot pipe, up the chimney-flue, and be delivered in any upper-room next to the same flue and requiring warmth and ventilation, the process of ventilation applied to the lower room being applicable to the upper room also.

The indicated means by which winter ventilation is obtained are not of course equally efficient in summer, for the draught of the fire is wanting; but the inlet at the low level for fresh air, and the outlet for the spent air at the upper level, continuing always open, the heat which the flue will in most cases retain through the summer aided by that of the sun's rays upon the chimney top, secures a certain amount of up-draught, which is not without its effect upon the in-draught by the lower inlet, even when windows and doors are shut.

While it is obvious that the air drawn into any house for the purpose of in-door ventilation need not be other than that which would enter by the windows of the same house, it may be unnecessary to enter into any inquiry as to the condition of the air heretofore spoken of as fresh and pure. "Fresh" and "pure" applied to air must be taken to mean the freshest and purest immediately obtainable, and that will be the same whether it be drawn in through a grated hole in a wall, or by a glazed opening close by it in the same wall. But it is a fair subject for inquiry whether,—speaking in London to Londoners,—the air about our houses in London is as pure—or as free from impurity—as it might be.

The out-door ventilation of large towns may be taken to be more complete above the tops of the houses and of their chimneys than it is, or, perhaps, can be, among and about the houses:—the processes of Nature are there not only unchecked, but are in fact aided by the heat thrown up by the chimneys into the upper air, and impurities which can be passed off by chimney flues, will be more certainly and more effectually removed and changed by Nature's chemistry, than if they are kept down to fester under foot and to exhale in our streets and about our doors and windows.

At this time every endeavour is made to provide for removing from our dwellings all excrementitious matter, and all soluble refuse, by drains into sewers, and so by the sewers to some outfall for discharge. The drain necessarily falls towards the sewer, and the sewer again to its outfall, and the sullage or soil drainage being rendered liquid, thus passes in the usual course. But the usages and the necessities of civilized life cause a large proportion of the liquid refuse from dwelling-houses to pass off in a heated state, or to be followed by hot water arising from culinary processes, and from washing in all its varieties. The heat so entering the drains causes the evolution of fetid and noxious gases from the matters which go with, or have gone before, the hot water; and with these gases house drains, almost always, and sewers commonly, stand charged. They are light fluids and do not go down with the heavy liquid matters from which they have been evolved, but they seek to rise, and constantly do rise in almost every house through imperfections or derangements of the flaps and traps which are intended to keep them down; but which only, when they do act, compel some of the foul air to enter the sewers, and there to seek outlet to the upper air which they find by the gulley gratings in the streets.

It can hardly be said, perhaps, that *too much* attention has been given of late to the scour of sewers by water, but it is most certain that too little attention has been given to the con-

* The appliances used by Mr. Hoskins will be found more fully described in his "Healthy Homes," published by Mr. Murray.

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